

# AN APPROACH TO RECYCLE RUBBER USING THE MECHANICO-CHEMICAL METHOD OF DEVULCANIZATION

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How to reduce rubber waste? To reduce rubber waste there are several options. The most well known method is to burn the rubber waste to produce energy while producing cement. Due to its irreversible network and the different compounds and ingredients the recycling of rubber is not comparable with the recycling of plastics. In most cases the methods show unsatisfactory results for reuse. So the recycled rubber is typically used as an inactive filler for simple undemanding products. In this research the aim is to produce recycled rubber which can be used without any additional ingredients.

## Introduction

Devulcanization provides an opportunity to recycle rubber. There are several processes to devulcanize: mechanical, chemical, mechanico-chemical, biological and with the help of microwaves or ultrasound. The chosen mechanico-chemical method has the advantage of being highly efficient, rapid and technically applicable.

## Experimental

On one side the project aims to devulcanize by the mechanico-chemical method. Different polymers should be recycled using the internal mixer and adding so-called devulcanizing agents. Therefore the internal mixer is filled with the polymer and the devulcanizing agent. Through variation of temperature, mixing time, rotation speed, concentration of the devulcanizing agent, particle size and filling degree the rubber is going to be devulcanized. On the other side the networking, depolymerisation and the re-networking is accomplished with model molecules. These molecules e.g. Squalene have lower molar masses. Because of this attribute the substances are liquid and thus much easier to handle and analyse, i.e. it is possible to crosslink Squalene with the aid of sulfur and an accelerator.

## Analytics

The viscosity of all samples produced is checked. With the aid of IR measurements it is possible to confirm the preservation of the double bond character. Furthermore GPC measurements will follow to get information about the distribution of the molar mass. Results of GPC measurements show the dependence of the time of crosslinking and the content of sulfur. The molar masses fluctuate between the dual and dicuple mass of one molecule of Squalene.

## Outlook

- a) The procedure has to be optimized. The optimized devulcanized mixture will be mixed in different parts with the original mixture. Sulfur, accelerator and crosslinking agent will be added. Afterwards the mixture will be revulcanized. The quality of the different types of revulcanized rubber will be investigated by measuring their physical properties, i.e. stress-strain measurements. Ideally the devulcanization and subsequent revulcanization should be accomplished continuously using a twin-screw-extruder.
- b) The crosslinked model molecules are to be devulcanized and analysed by means of NMR, IR and further GPC measurements.

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